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USSR: Materials Science

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USSR: MATERIALS SCIENCE

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Solubility of GaAs in Bi-Ga Melts

18420045a Moscow IZVESTIYA AKADEMII NAUK SSSR: NEORGANICHESKIYE MATERIALY in Russian Vol 23, No 10, Oct 87 (manuscript received 26 Dec 85) pp 1607-1609

[Article by N. A. Yakusheva and S. I. Chikichev, Semiconductor Physics Institute, Siberian Department, USSR Academy of Sciences]

[Abstract] An experimental study was made concerning use of binary Bi-Ga melt for epitaxial growth of GaAs layers from the liquid phase. Three liquidus isotherms (700°C, 800°C, 850°C) obtained by measurement indicate that the solubility of GaAs first increases to a maximum near 10 atom.% Bi and then decreases to a minimum near 85 atom.% Bi before increasing again steeply as the melt composition reaches 100 atom.% Bi, the maximum solubility of GaAs being about 0.8 mol.%, 2.4 mol.%, 4.1 mol.% at 700°C, 800°C, 850°C respectively and the minimum solubility of GaAs being 0.2 mol.%, 0.8 mol.%, 1.2 mol.% at 700°C, 800°C, 850°C respectively. The experimental results disagree with theoretical calculations according to the model of regularly associated solutions. They yield an inverse exponential temperature dependence of the solubility of GaAs (expressed in As atom.%) in a binary Bi-GaAs melt. References 13: 7 Russian, 6 Western.

UDC 346.48'221

Effect of Intrinsic Defects in CdS Structure on Efficiency and Optical Strength of Uncooled Lasers

18420045b Moscow IZVESTIYA AKADEMII NAUK SSSR: NEORGANICHESKIYE MATERIALY in Russian Vol 23, No 10, Oct 87 (manuscript received 27 Dec 85) pp 1618-1622

[Article by O. V. Bogdankevich, N. N. Kostin, Ye. M. Krasavina, I. V. Kryukova, Ye. V. Markov, Ye. V. Matveyenko and V. A. Teplitskiy, All-Union Scientific Research Center for the Study of Surface and Vacuum Properties]

[Abstract] An experimental study of uncooled semiconductor lasers with a CdS single crystal as active medium has for the first time revealed that it is possible to improve their performance by regulating the concentration and the type of intrinsic structural defects. Single crystals in wafer form were produced under either S or Cd vapor pressure controllable from 20 kPa below to 60 kPa above atmospheric. Specimens of bilaterally polished plane-parallel 200-220 μm thick CdS wafers, inside a cavity between a 90% reflectance front mirror and a 30-50% reflectance exit mirror, were longitudinally pumped with an up to 200 keV electron beam in pulses 0.8 ns long passing through a

circular diaphragm 0.5 mm in diameter at room temperature. An MIRA-4D x-ray machine served as electron accelerator. Measurements of differential quantum efficiency, critical power density corresponding to optical breakdown, and threshold current density revealed their much more sensitive dependence on the S vapor pressure than on the Cd vapor pressure in the crystal growth process. The optimum gauge pressure of sulfur vapor was determined to be approximately 40 kPa, producing CdS crystals with the highest differential quantum efficiency (10.4%) and the highest critical power density (11 MW/cm^2) as well as the lowest threshold current density (72 A/cm^2). A similar result could be achieved by doping with fine impurity such as Ga. The intensity of edge photoluminescence was also found to have much higher peaks, both blue and green, than that of crystals grown under any other S vapor pressure. The power-current characteristic of such a laser is noteworthy, its slope increasing abruptly somewhere within 300-400 A/cm^2 range of current density. References 11: 9 Russian, 2 Western.

UDC 666.1

Interaction of Vitreous P-Se Compounds and Silver

18420045c Moscow IZVESTIYA AKADEMII NAUK SSSR: NEORGANICHESKIYE MATERIALY in Russian Vol 23, No 10, Oct 87 (manuscript received 24 Dec 85) pp 1713-1715

[Article by Z. U. Borisova, V. S. Vorobyev and O. A. Golubeva, Scientific Research Institute of Chemistry, Leningrad State University imeni A. A. Zhdanov]

[Abstract] An experimental study was made concerning the interaction of glassy P-Se compounds and silver. Specimens of PSe_{20}, PSe_9, PSe_4, P_2Se_5, P_2Se_3, PSe, P_4Se_3, P_2Se were synthesized from extra-pure elementary P and Se under vacuum in quartz flasks at a temperature of 400°C, fusion and partial interaction occurring within 2 h, whereupon the furnace temperature was raised to 700°C for 3 h and the melt was then quenched in air. Silver was added in amounts of 0.5-10 atom.% Ag, alloys formed by addition of 0.5-3 atom.% Ag to the glassy compounds PSe_9, PSe_4, P_2Se_5, P_2Se_3 remaining X-radiographically amorphous and alloys containing 5-10 atom.% Ag becoming glassy-crystalline. The crystalline phase in the latter alloys was the not vitrifiable ternary compound $Ag_4P_2Se_6$. The density of glassy P-Se compounds was found to increase almost linearly with increasing Ag concentration, their microhardness remaining almost unchanged even though the glass transition temperature increased with increasing Ag concentration. Addition of Ag was found to appreciably increase the electrical conductivity and lower the conductivity activation energy, both nonmonotonically, indicating a transition from dielectric to semiconductor and then to solid electrolyte. References 8: 4 Russian, 4 Western.

2415/5915

Composites: Future Development and Use Discussed

18420057 Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 27 Oct 87 p 2

[Article by D. Pipko, editor, Science and Technical Progress Department, SOTSIALISTICHESKAYA INDUSTRIYA, under the "Reserves of Acceleration" rubric: "Composites: Future Development and Use Discussed"; the first five paragraphs are SOTSIALISTICHESKAYA INDUSTRIYA introduction]

[Text] "Give me a fulcrum, and I will move the world", said Archimedes, trying to prove the advantages of a lever. For designers and developers, structural materials have always been such a fulcrum. Among these materials, composites, which combine high strength with light weight and durability, are promising a real breakthrough in the machine building and other branches of the economy. Application of composites in machines, equipment and structures makes it possible to reduce:

- mass of structures by 25-50%;
- labor consumption in manufacturing by a factor of 1.5-3;
- energy consumption in production by a factor of 8 to 10;
- material consumption by a factor of 1.6-3.5.

Using composites, one can increase equipment service life by a factor of 1.5-3, reduce losses to corrosion to a minimum and reduce consumption of fuel by mobile equipment and vehicles.

Unfortunately, the share of composites in the total mass of structural materials used in our country has been so far very small. How to drastically expand the sphere and increase the scope of application of composites in the shortest time possible? This question became the subject of discussion at the "round table" conversation at the SOTSIALISTICHESKAYA INDUSTRIYA editorial office.

Academicians I. Fridlyander and N. Yenikolopov; Deputy Minister of the Aviation Industry A. Bratukhin; Deputy Minister of the Chemical Industry S. Golubkov, expert of the Administration for Interindustry Technology, GKNT [USSR State Committee for Science and Technology], V. Borisov; Director, All-Union Aviation Materials Institute (VIAM), Doctor of Technical Sciences, Professor R. Shalin; Deputy General Director, NPO [scientific production association] "Khimvolokno" G. Budnitskiy; and Doctor of Chemical Sciences, Professor A. Berlin took part in the discussion.

Today we are publishing a report on the meeting.

The Thinner, The Stronger

"When it turns out that we lag in a certain field of science and technology, everybody begins alluding to difficulties with implementation", this is how Academician N. Yenikolopov started the "round table" conversation. "Conservatism of production personnel, prejudice and scepticism are also named as reasons. But talking of the reasons that impede the broad implementation of composite materials today, I would assign the first place to ignorance."

Academician I. Fridlyander supports his colleague: "Even mature and experienced specialists cannot hide their bewilderment: 'What is all the ado about anyway?' And when you name fiberglass as the simplest example of a composite, they sigh with relief: 'That's all there is to it?' If you then try to convince them that new fibers will soon become the main structural material, you start catching their ironic glances. Unfortunately, a large number of designers are still convinced that a steel beam, a concrete slab or, if worst comes to worst, a pine log is the thing. And all these fibers and composite materials are just the usual fantasies of scientists..."

"In order to know how much and what type of fibers and plastics will be required from us in the very near future, we have polled 11 machine-building ministries", adds Deputy Minister of Chemical Industry S. Golubkov. "But we were not able to find among their products even one, repeat, even one made of composites. Worse yet, nobody could name a product which is planned to be made of composite materials. This means that the majority of machine building industries have practically neglected one of the decisive opportunities to improve their technical level..."

Have composites come, figuratively speaking, like a bolt out of the blue? Not at all. At least 50 years ago it had been proven that, theoretically, crystalline materials used by humankind could be many times stronger. Scientists had also found the reasons for their lower strength: microscopic cracks and defects in material structure. How to avoid them or at least reduce their number? It turned out that the most practical method is to convert material to a very fine fiber: then there just will be no room for defects in its cross-section.

Practice has proven the theoreticians' forecasts: converting to a fiber helped increase the specific strength of materials by a factor of 10, 20, even 100. Filaments began to be made of silicon carbide, glass, aluminum oxide, boron and organic substances. There was a sensation too: the finest steel wires yielded the palm to carbon fibers. The latter already have their "champions" that are five times lighter than steel and are three times stronger than best steel grades. But even these fibers are of little importance per se.

The cross-section of a carbon fiber bundle can be one-third that of the thick steel beam it replaces. But because fibers are thinner, the bundle must consist of thousands and millions of them. How to make them work "in harness" and protect them from shocks and other destructive actions? The answer is

known from the example of glass fibers, wherein the glass filaments are immersed in polymer resin. One can also use construction panels as an analog, during whose manufacture concrete hardens around stretched steel strings. This "around" specialists call a matrix, or a binder. Together with fibers, it forms a composite material. Moreover, it is the binders rather than the fibers that make it possible to divide composites into three basic classes: polymer, metal and ceramic.

Unfortunately, not all industry specialists know even this general information on the essence of composites: information on these materials is extremely scarce and is disseminated in the general flow of information. The only magazine, MEKHANIKA KOMPOZITNYKH MATERIALOV [Mechanics of Composite Materials], published in Latvia, cannot answer all questions that arise. And before one can use something, one has to know it. This is why the "sound table" participants stressed that the problem of the broad introduction of composites is in need of a dependable information support. Organization of such support is the direct responsibility of specialists at the GKNT.

Today, many thousands of tons of products made of composites (based mainly on polymer binders) are manufactured all over the world. But these materials can only function at temperatures below 200°. The borderline for application of metal composites of the aluminum and magnesium type reinforced with carbon fibers, is around 500°. Then there are materials based on titanium and nickel alloys. And at temperatures up to 1,700°, only silicon carbide or nitride ceramics can function. But here again, carbon is the record holder: permeated with carbon fibers, it can function even at 2,500°.

This alone shows that composites can replace the most varied materials. What are their advantages? Where are they already used and where will they be used in the future?

Where Is the World Hurring to?

"In the giant transport aircraft 'Ruslan', we only used 5.5 tons of composites", says VIAM Director V. Shalin. "But they saved us 15 tons of metal and made it possible to reduce fuel consumption over the aircraft's operating life by 18,000 tons. Composites will be used even wider in the IL-96 and TU-204 aircraft that are now under development. And in a helicopter designed by the Design Bureau imeni N. Kamov, the share of composites is equal to 53%. Due to composites, it was possible to reduce the structure weight by 25-30%, double and triple the service life and reduce labor consumption in manufacturing by a factor of 1.5-3..."

In the opinion of specialists, by the end of the century the share of composites in the structure of subsonic aircraft will reach 30 to 40% and even up to 50% in that of supersonic aircraft. Composites will play a special role in a hypersonic passenger aircraft which would be able to fly at altitudes up to 30 km at speeds many times that of sound. American specialists are planning to make its wings and tail assembly of carbon-carbon composites, its air intakes and engine jets of ceramics, and its chassis of carbon-aluminum and carbon-magnesium materials. Soviet aircraft manufacturers also showed at the Le Bourget salon a model of such a hypersonic aircraft that can bring passengers from Moscow to Khabarovsk in an hour.

"The world's automotive industry also counts on composites", says Academician I. Fridlyander. "Even now, it manufactures thousands of motor vehicles with parts made of plastics and new materials. The reign of metals in vehicles will soon come to an end. In the opinion of leading American specialists, at the end of the century the share of plastics and composites in motor vehicles will reach 65%. They will be used in corrosion-proof underbodies, springs, body panels and bumpers. Safety tests have proven the absolute fitness of bodies made of plastic-based composites. And ceramics, reinforced with ceramic filaments, seem to be the most promising material for engines..."

Specialists in the agricultural machine-building industry are also interested: they are attracted to composites by the combination of their high strength and high corrosion resistance. Developers of high-speed railroad trains of the future see in composites a real possibility to break the vibration barrier. No traditional material can reliably resist vibration. Composites can.

Pipeline transport also lays claim to composites. Steel pipes are heavy, costly, must be protected from corrosion and often leak. It is impossible to do without them in main pipelines yet. But distribution lines can be made of reinforced plastics. The proof is in the USA experience, where around 40,000 km of distribution pipelines are built annually: 85% are made of plastics, and their life is several times longer than that of steel pipes.

In construction, attempts have been made for a long time to replace the metal in reinforced concrete with fiberglass. However, one was not able to do it because the alkali in mortar attacked glass. But in England, they were able to make alkali-resistant fiber recently. And widespread application of glass-concretes began.

"Basalt fibers are also of great interest", continued Academician I. Fridlyander. "We have practically unlimited reserves of raw materials for their manufacture. At the Problems of Materials Science Institute, UkSSR Academy of Sciences, fibers have been developed that can be used for reinforcement of plastic pipes and concrete products. It has been determined that converting to basalt-concrete structures would make it possible to save from 5 to 10 million tons of steel annually. But unfortunately, neither glass-gypsum, nor glass-concrete, nor basalt-concrete attract our construction industry..."

The "round table" participants noted that such passiveness cannot but cause alarm. In order to reach the level of composite use in the leading capitalistic countries, one should immediately start full-speed work on their introduction. One should also remember that the effect from the use of composites depends on their share in the structure of a machine, a unit or an equipment complex.

"We need a new program of chemicalization of the machine building industry", stated S. Golubkov. "It is time for designers to cease specifying plastics only for handles and decorative elements. Plastocomposites can be used in rather high-loaded parts. It would be therefore necessary to specify for each machine or unit the year it is scheduled for and the percentage of composites in it..."

"For this program to be constantly under control, one should create a sort of a "chemical nucleus" right in the Machine Building Industry Bureau", suggested G. Budnitskiy, Deputy General Director, NPO "Khimvolokno".

Minkhimprom [USSR Ministry of the Chemical Industry] concern is understandable. The industry has been given a goal to sharply increase production volume of fibers and binders and expand their nomenclature. It must also organize the production of semifinished products, such as binder-impregnated fiber bundles, tapes and fabrics, as well as angles, channels and other structural shapes made of composites. Mintsvetmet [USSR Ministry of Nonferrous Metallurgy], Minchermet [USSR Ministry of Ferrous Metallurgy] and Minpromstroymaterialov [USSR Ministry of the Construction Materials Industry] have been also given serious assignments for production of metal and ceramic composites. But who will buy all these products? So far ... nobody buys even the modest amounts of components that the chemists can offer their customers. One of the main reasons is the absence of processing equipment. The following data were given during the "round table" conversation: at the start of the mastering of composites, we had to buy the majority of the 1,600 necessary machines and units abroad.

Machine Building: the Stumbling Block

Composites have a unique feature: they make it possible to start in real earnest the development of materials with predetermined properties. Take a tank, for instance: the strength of its walls around the circumference must be approximately twice as high as in the longitudinal direction. Composites make it possible to meet this requirement withoug wasting a gram of material: one should only wind twice as many filaments around the circumference as along the tank. When the load pattern is more complicated, the part base can be woven or knit like a sweater, placing exactly as many fibers as necessary in each direction.

"Owing to composites, we have been able to develop materials for the actual load pattern a part encounters", says A. Bratukhin, Deputy Minister of Aviation Industry. "Moreover, in many cases the material itself emerges only in the process of manufacturing a product. This explains the special requirements on equipment. For instance, in order to lay the reinforcing base, NC machines with high precision of tool motion are needed. Programs for them must be computer-calculated, taking into account fiber and binder properties and their mutual positioning. Moreover, manufacturing complexes and systems must "sense" specific features of the composites, respond immediately to deviations from technological standards and flexibly adjust to operating conditions that guarantee the required quality of the products..."

"Just as we mainly use alloys rather than pure metals, the world is starting to evermore widely use hybrid composite materials", Academician N. Yenikolopov joined the conversation. "One fiber can have high stiffness but low strength, another one has opposite properties. Let's say, that glass fibers work well in compression. Organic filaments cannot stand compression; however, they withstand high tension loads. By combining them, one can obtain a hybrid material with the required combination of properties..."

"Binder hybridization is also done", adds Academician I. Fridlyander. "For instance, thin aluminum sheets reinforced with boron fibers are glued, layer-by-layer, with organoplastics. As a result, a material with unique vibration resistance is obtained. It is with its help that developers of high-speed trains hope to break the vibration barrier. In order to make laminated panels that are, say, 30 m long, unique presses are needed. In order to impregnate fibers with binder, one needs large autoclaves. And in order to manufacture metal composites, aluminum has to be plasma-sprayed onto fibers in vacuum chambers. You can see for yourself that these are not simple machines and units: not everybody can make them."

"But this does not mean that only specialized equipment is needed for making composites", clarified A. Bratukhin. "On the contrary, in many cases one can use universal equipment that is used in various industries. When solving the problem of the sharp increase in equipment manufacturing, one should take this fact into account. Particularly, Minstankoprom [USSR Ministry of Machine Tool and Tool Building Industry] should become more active in developing machinery for winding and laying fibers, Minkhimmash [USSR Ministry of Chemical and Petroleum Machine Building] should become more active in manufacturing complete autoclave systems, and Minpribor [USSR Ministry of Instrument Making, Automation Equipment and Control Systems] should become more active in manufacturing automated lines for nondestructive testing..."

This gave rise to a conversation about new and more efficient forms of work organization. For instance, the majority of "round table" participants supported the idea of creating firms, capable of the production turnkey delivery and servicing of completed equipment complexes. The role of such firms can be played by interindustry scientific production complexes (ISPC) or State production associations "Kompozitmash". They must have their own enterprises (for accelerating the matter, the enterprises should be taken away from appropriate industries), as well as the right to place orders for standard equipment with plants that traditionally make this equipment.

Many specialists think that at the beginning stage the process can be sped up by deep cooperation (spreading parts manufacturing among a large number of plants) and mainly leaving the assembly to "Kompozitmash". In order to guarantee a high technical level, it was suggested to use the advantages of small enterprises that only make one or two different types of equipment.

"One should also provide for the organization of the production of ancillary, or, more appropriately, "technological" materials, such as sealing films, special lubricants and coatings, tapes for securing blanks and other technological elements", A. Bratukhin emphasized, "Often, due to the low quality of technological elements that are less than a ruble a piece, hundreds and thousands rubles' worth of parts and products are rejected..."

If One Starts With a Clean Slate

Let us assume that production of components for making composites has been organized. Machine builders, being themselves interested in their wide application, have organized production of appropriate equipment. Does it mean that the problem has been already solved?

"We will not get things moving unless engineering centers for composite implementation are created in each machine-building industry and even in the construction industry", S. Golubkov said with conviction. "They can be created on the basis of head institutes, but they must have maximum independence. Let's say, on all composite related problems the manager of such a center reports only to a Deputy Minister..."

"It is easy to issue an order on creating such centers", V. Borisov objected. "But where do you get people who not only can work at these centers but are capable of accelerating the problem's solution? At best, in the entire country there are only a few thousand specialists who are knowledgeable about composites. And the majority of them are employed in the aviation and missile industries. Of course, nobody will give them to you."

These industries have their special tasks. It is therefore undesirable to even divert these people, say, for teaching courses. It means that all remaining industries must retrain their employees, sending them to places where composites have already been mastered. And send them not as excursionists that should be entertained. Let them work on an equal footing with their hosts: then they really will know what is what. And for the hosts, the visitors' labor will be a sort of payment for science.

"I would not solely rely on retraining", objected S. Golubkov. "This way, we can satisfy the immediate hunger for personnel. But one should remember that habits and skills acquired in one's previous profession are hard to break. I, for one, saw a bike made of composites, where the designers used metal handbars. Why? Because they were afraid the bars would break. But it did not occur to them to change the shape for a better load distribution. Inert thinking is a dangerous thing. With it, one cannot make a breakthrough. I think that along with retraining one should give young specialists assignments in solving specific problems with a clean slate, so to speak. Let them smash their noses and learn the new thinking..."

The personnel problem is even more acute at the production level. In order to organize wide introduction of composites, thousands of enterprises must have employees with know-how. Know-how to lay fiber along load lines, how to impregnate it with a polymer compound, how to "set" it, using metal melt, and how to test reliability of the binder-fiber bond.

But specialists are not the only problem. Each enterprise will have to be equipped with a complete set of equipment for manufacturing composite parts. And the equipment must be highly efficient in order to reduce the production cost and labor inputs. But then only automotive giants and similar mass-production enterprises will be able to keep this equipment busy, whereas at medium-size and small enterprises it will often be idle.

"There is a well-known solution to this problem", objected G. Budnitskiy. "One should create specialized production facilities within the framework of individual industries. Better yet, in order to avoid freight charges, one should build specialized "Tsentrolit"-type plants in large industrial centers. Let them manufacture composite parts on orders from enterprises of any industry. Even for municipal customers. Who to make these

"Tsentrokompozites" subordinate to? One can make them subordinate directly to the Machine Building Bureau. Unusual? But we are starting with a clean slate, so to speak. Why not take chances?..."

A lot of such questions are raised during the "round table" conversation. Everybody understood that a gigantic breakthrough was needed in the composite field. Other countries are getting ready for it too. The USA and Japan have national programs in place. New types of composites are immediately tested and recommended for use in various products, including household and sport-related products. Ever better equipment is being developed. Outwardly, the process is similar to critical mass accumulation that can result in an explosion. And then composites will take the dominating position in industry. Are we ready for such a turn of events?

"Not yet", Academician N. Yenikolopov answered. "I am afraid that without taking serious and drastic measures we will not be able to catch up..."

Roots of the Problem and the Management Crown

"Recently, I visited a Gosplan [USSR State Planning Committee] department, where extralong-term estimates are made. Particularly, for the year 2010", Academician I. Fridlyander picked up the conversation. "I was amazed to find out there that for the next 20 years we will keep investing billions and billions of rubles, trying to keep and even slightly increase the current steel production volume. I get the impression that Gosplan employees are unaware of world trends. Or do they still think that the entire world is marching to the beat of the wrong drummer? We too should set a goal of considerably reducing steel production by the year 2010..."

The statistical data are clear: in little over 20 years, annual steel production in the USA declined from 136 to 80 million tons. In Western Europe too, enterprises are being closed, and the EEC pays bonuses to its member-countries for reducing their metallurgical capacity. And in Japan, some ferrous metallurgy plants have switched to fiber manufacturing.

"By cutting down the use of metal parts we will be able to stop using hundreds and thousands of expensive machine tools, eliminate the tremendous consumption of energy for metal working and stop the exhausting and often hopeless fight against corrosion", says G. Budnitskiy. "On the other hand, only composites can guarantee the high reliability and longevity of certain types of machines."

"We think that all industries that make structural materials should be considered from a unified position", Deputy Minister of the Chemical Industry S. Golubkov adds. "Nothing is free. Nowadays, in order to make a breakthrough along a promising direction, huge amounts of effort, money and resources are needed. There is not enough for everybody. And it is not necessary to scatter them. On the contrary, the money and resources should be given to those who are capable of achieving the highest economic efficiency. But we keep persistently clinging to old patterns..."

"The science of composites is still in its early development stage", Academician N. Yenikolopov noted. "We can realize tremendous gains if we invest the necessary effort and resources in it..."

A. Berlin continued the thought: "It is high time to admit, and not just by word but by deed, that revolutionary breakthroughs in technology and production always come from basic sciences. Composites themselves, having been born at theoreticians' pen tips, are a living proof of this. If we want to be at the world level in this field, we must take care of expanding research, first of all within the academy system."

"I think that not just science, but customers too must look ahead", objected G. Budnitskiy. "Why do you think the specialists at the Terray company have left everybody behind with their superstrong carbon fiber? Because 10 years ago the aviation industry had set a goal: by a certain year we would need fibers with certain properties for certain parts. And money was provided for research and development. I think that in our country, too, organization of the work should stipulate active customer participation. Including financial participation..."

"I think that as far as its scope and importance for national economy is concerned, the problem of the development and introduction of composites well deserves to become a subject of one of those State Integrated Goal-Oriented Programs that GKNT Chairman B. Tolstykh described in your newspaper," Academician I. Fridlyander sort of summarized the conversation. "The research part of the program must be aimed at developing composites with outstanding properties. And assignments must be scheduled on a yearly basis. The Academy of Sciences must be responsible for fulfilling this research part..."

The specialists and scientists who took part in the "round table" conversation stressed that it is not an accident that the world has been counting on composites. The possibilities for improving the characteristics of traditional materials, including steels and aluminum alloys, are practically exhausted. Therefore, only by using composites is it possible to radically improve the quality of machines, equipment and instruments and to change the entire machine-building industry. In the specialists' opinion, it is possible in the long run to develop composites that would change their properties depending on operating conditions and adjust to them like a living organism.

All this means that we have a lot of work ahead of us for many years to come. But today more than ever, a breakthrough is needed in the development and introduction of composites. How to make it? What measures must be taken and what kind of organizational changes must be made in order to move things ahead speedily? In order to answer these and other questions on the use of composites, the SOTSIALISTICHESKAYA INDUSTRIYA editorial board intends to continue the conversation begun at the "round table". We are waiting for letters with your opinions and suggestions which, we hope, will help accelerate the solution of the problem.

12770/5915

UDC (669.294+669.15'24'26-194):539.219.3

Interdiffusion During Annealing of Composite Material Consisting of Cr18Ni10Ti Steel and Tantalum

18420049 Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 64, No 3, Sep 87 (manuscript received 23 Jun 86) pp 515-520

[Article by B. I. Kosilo, L. I. Polezhayeva, L. P. Polyakova, Ye. G. Polyakov and A. B. Smirnov, Institute of the Chemistry and Technology of Rare Elements and Mineral Resources, Kola Branch imeni S. M. Kirov, USSR Academy of Sciences]

[Abstract] An experimental study of a bimetallic composite material consisting of stainless steel (Cr18Ni10Ti) tape and bilateral tantalum coating, this material being produced electrolytically in a salt melt, has revealed a certain pattern of interdiffusion during annealing. Specimens of such tape were annealed at a temperature of 1573 K in an SShVL 1,2,5/25 MO1 furnace containing a pure argon atmosphere. Transverse cuts were examined under an REM-200 scanning electron microscope as well as under an optical microscope, and in a "Cameca MS-46" x-ray spectral microanalyzer with electronic probe before annealing as well as after 30 min and after 90 min of annealing. Three intermediate layers were found to build up during the first 30 min, one with nonuniform composition on the steel side and a Ta(Ni,Fe,Cr) intermetallic one on the tantalum side with a very thin (2-3 μm) hypothetically Ta_2(Ni,Fe,Cr) intermetallic interlayer on the tantalum surface. After the steel thickness and the tantalum thickness had thus been reduced by 27-28 μm and by 12-13 μm respectively, the former was further reduced by 62 μm and the latter remained constant during the subsequent 60 min of annealing. Evidently the two intermetallic layers inhibit diffusion of Ni,Fe,Cr from steel into tantalum, while tantalum can diffuse deeply into steel along grain boundaries. References 2: 1 Russian, 1 Western.

2415/5915

Metal Consumption Program Discussed

18420058 Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 17 Nov 87 p 1

[Article: "More Not Always Better: 'Metal Consumption' Program Adopted"; Interview with First Deputy Minister of USSR Ferrous Metallurgy L. Radyukevich by SOTSIALISTICHESKAYA INDUSTRIYA correspondent I. Zhagel]

[Text] Nowadays, we are getting to know in practice a simple truth: it is not the one who has a lot that is rich, but the one who manages his property in a businesslike manner. While making more metal than anybody in the world, we constantly experience a metal shortage. It is not surprising: we use more than twice as much metal as the USA per unit of national income.

Recently, a long-term integrated program of reducing the metal content of national income was adopted. This program covers all branches of the national economy. But the fight for metal savings starts where metal is made. Our reporter, I. Zhagel, asked First Deputy USSR Minister of Ferrous Metallurgy L. Radyukevich to tell about the metallurgists' tasks in implementing the integrated program.

[Question] Leonid Vladimirovich, first of all please name the end goals of the "Metal Consumption" program.

[Answer] It covers the period up to the year 2000. By that time, it is planned to cut the unit material content of national income in half, compared to 1985. As a rule, all the increase in the production volume will be achieved by savings of metal products, and especially of rolled metal.

[Question] When one gets acquainted with the program, one can see clearly how much depends on a qualitative leap in the operation of your industry.

[Answer] You are right, we need a qualitative leap. Because, as far as quantity is concerned, we have already reached a reasonable limit. A further increase in metal production means its direct waste. It is not an accident that a decision has been now made to limit production of pig iron; similar measures are being taken in regard to steel.

But this does not solve all the problems, as even maintaining metal production at the level achieved costs more and more money, because each year ore and coke

are more and more expensive. At present, approximately one-fourth of all capital investment goes for maintaining the prior ore mining volume. It is a vicious circle: we should increase financing for retooling and mastering new manufacturing processes, but we have to spend a large portion of the money for maintaining existing production volumes and increasing production of rolled stock. This negative trend must be overcome as soon as possible.

And speaking of the specific quality indices that our industry must achieve according to the "Metal Consumption" program, the goal has been set: by the end of the century to make steel mainly by the oxygen-converter method and in electric furnaces. Approximately 80% of the steel will be continuously cast. The share of sheet metal will reach 55-60%; the share of corrosion-protected metal will increase by a factor of 3-3.5. Production of roll-formed sections will also increase.

To a large degree, the success of the "Metal Consumption" program will also depend on how well we will supply necessary metal products for national economy, both quantity- and range-wise. And we are not only talking of mass orders and big customers. Unfortunately, it still happens rather often that an enterprise that places a low-tonnage order is in an unfavorable position. The thing is that, as a rule, the ferrous metallurgy industry operates powerful high-output units, and restructuring them for small orders leads to large losses. Therefore, it is now necessary to develop manufacturing lines that are easy to reset for low-tonnage runs and that would even specialize in such runs.

[Question] These are tough goals. Are the industry enterprises ready to meet them?

[Answer] We have embarked on the course of retooling old plants. Reconstruction of the Magnitogorsk and Kuznetsk combines, Zaporozhstal and the Alapayevsk plant has begun. Unfortunately, the machine builders are supplying only about 60% of the metallurgical equipment needed for implementation of these plans.

There are a lot of cases when we are supplied units that do not match the highest world level and embody obsolete technical solutions. Suffice it, for instance, to compare a domestic rolling mill that has been recently installed in Karaganda with similar equipment from West Germany that has been installed at the Novolipetsk combine. This is especially true as far as the level of unit automation and the use of modern product quality control methods are concerned.

And still, during the current Five-Year Plan over 100 rolling mills will be modernized. Work is proceeding also on developing new technological processes, particularly those related to non-blast-furnace metallurgy. Introduction of equipment for continuous casting of steel that makes it possible to considerably reduce metal losses will yield great savings.

In solving retooling problems, a lot will depend on the industry's science. Recent analysis has identified serious shortcomings in its work. Based on a Ministry decision, departments and laboratories that had been making no headway

were disbanded. The number of subjects that institutes work on has been drastically reduced. In turn, 46 industry programs, aimed at solving the most important problems, have been adopted.

Economic levers will also be put in action. Beginning in 1988, all enterprises in the industry are to switch to full cost-accounting [khozraschet] and self-financing. We have tested elements of the new management system at the Magnitogorsk and Novolipetsk combines. The results were positive.

In particular, the new principles, on the basis of which next year's plans have already been compiled, will facilitate the overcoming of current shortcomings. For instance, these plans do not contain steel production targets: only products to be marketed, such as rolled stock and billets, are planned. Of course, enterprise collectives will need some time for restructuring. But there is no doubt that very shortly this measure will help one to more completely meet customer demand and to improve the quality of metal products.

However, there is a nuance here that I would like to clarify. Sometimes quality can be, so to speak, excessive. For instance, a standard requires that a certain product meet 10 or 11 indices, but only five or six of them are important to the customer.

Recently, Gosstandart [USSR State Committee for Standards] has allowed our plants to sign direct technical agreements with customers on shipment of metal products. However, as if they scared theselves by this step, attempts started immediately to limit it with various addendums and clarifications.

In order to be zealous businessmen, we must learn to utilize metal scrap too. But so far anything that does not fit standards and specifications is sent for remelting, although the so-called substandard products could be widely used in construction and agriculture. There were cases when we sold substandard rolled stock abroad almost at scrap prices, and it was used there to make household appliances and toys.

[Question] You have touched on a very sore problem, that of relations between suppliers and customers. The thing is that according to the "Metal Consumption" program the number of new types of products manufactured by metallurgical enterprises must sharply increase.

[Answer] There are a lot of problems here. One of them is that developers of new machines and mechanisms often use in their designs much more sophisticated and expensive materials than is really necessary. This is demonstrated by inspections our specialists conduct in various branches of the national economy.

Here is another specific example. The industry now makes tens of thousands of tons of metal powders a year. We could make more, but the customer is not ready--he is not buying more. But in accordance with the integrated program we must increase the production of metal powders more than fivefold by the end of the century.

The situation used to be the same with the wide-flange beams manufactured at Nizhniy Tagil. At first, their sales also had been slow. To a certain extent we had been even lulled by the situation. But now construction workers are tearing us to pieces: "Give us this product!" Apparently, the time has come for us to also think of advertising and of expanding direct relations, so that suppliers and customers can faster find and better know each other.

12770/5915

UDC 621.983:669.14.258.5.29

Highly Plastic Hot-Rolled Sheet for Cold Stamping

18420054a Moscow KUZNECHNO-SHTAMPOVOCHNOYE PROIZVODSTVO in Russian No 10, Oct 87 pp 11-12

[Article by V. G. Ivanchenko]

[Abstract] A line of hot-rolled sheet steels ($08AlN_2$ - $10AlN_2$ - $15AlN_2$ - $20AlN_2$), covering the tire low-carbon range and containing aluminum as stabilizer, has been developed for cold stamping of intricate parts requiring high plasticity. They feature high impact strength, including at subzero temperatures down to -70°C, as well as high toughness and tough fracture. Their plasticity is characterized by 28-36% elongation with a normal anisotropy of 0.94-1.15, a 0.14-0.18 strain hardening exponent, and a 4.5-8% nonuniformity of plastic strain. The steels were comprehensively tested by the Erichsen method at the Automobile Manufacturing Plant imeni I. A. Likhachev in Moscow.

UDC 621.77.016.3.002

Introducing Technology for Rolling Sleeve Blanks for Production of Nuclear Power Plant Equipment

18420054b Moscow KUZNECHNO-SHTAMPOVOCHNOYE PROIZVODSTVO in Russian No 10, Oct 87 p 16

[Article by S. A. Yeletskiy, V. A. Reshetnikov, V. V. Telesh and E. Z. Sayfulin]

[Abstract] A technology for rolling sleeve blanks up to 8 m in diameter and 4 m long is proposed for production of large nuclear power reactors with ratings above 1500 MW during the 1986-2000 period. The mill, a radial one or a vertical one, is designed for rolling sleeve blanks of austenitic and pearlitic alloy steels. The configuration of inside roller, outside roller, and two centering rollers ensures high precision within minimum tolerances and almost 30% less waste of costly metals, less tool wear, 20-25% less labor content in forging operations, and 34-50% less labor content in machining operations than the conventional technology.

UDC 621.919.3:669.018.25

Introducing Strain Broaching With Hard-Alloy Tool in Enterprises of the USSR Ministry of Heavy and Transport Machine Building

18420054c Moscow KUZNECHNO-SHTAMPOVOCHNOYE PROIZVODSTVO in Russian No 10, Oct 87 p 17

[Article by L. P. Yudin and Ya. Sh. Turetskiy]

[Abstract] Rough and finish broaching of parts made of alloy steels 12CrNi3N$_2$, 40Cr or carbon steels St20, St45 as delivered or in normalized, annealed, or quenched state by means of strain broaches made of a hard alloy such as WCo8, WCo8-V, WCo15 is being introduced into heavy machine-building. These tools operate with high precision and minimum metal waste. Experience at three manufacturing plants (Sverdlovsk, Kyshtym, Darasun) shows both a reduction of metal waste and of labor content. Eventual elimination of chip removal will further reduce the manufacturing cost and increase productivity.

2415/5915

UDC 621.315.592

Crystallization of $Ga_xIn_{1-x}As_ySb_{1-y}$ Solid Solutions on GaSb and InAs Substrates

18420046a Moscow IZVESTIYA AKADEMII NAUK SSSR: NEORGANICHESKIYE MATERIALY in Russian Vol 23, No 10, Oct 87 (manuscript received 3 Jan 86) pp 1610-1614

[Article by A. E. Bochkarev, V. N. Gulgazov, L. M. Dolginov and A. A. Selin, Moscow Electronic Engineering Institute, State Scientific Research and Planning Institute of the Rare Metals Industry]

[Abstract] An experimental study was made concerning the crystallization of $Ga_xIn_{1-x}As_ySb_{1-y}$ solid solutions from the liquid phase on GaSb and InAs substrates whose lattice has the same period as that of the substrate lattice. The experiment was designed on the basis of theoretical calculations pertaining to equilibrium compositions of respective liquid and solid phases. The results establish the melt compositions and the degree of supercooling necessary for such a crystallization, the allowable range of Ga concentration being $0 \leq x \leq 0.3$ and no such crystallization being possible at temperatures above 820 K. References 9: 3 Russian, 6 Western.

UDC 541.123.3

Glass Formation in P-Se-Sb System

18420046b Moscow IZVESTIYA AKADEMII NAUK SSSR: NEORGANICHESKIYE MATERIALY in Russian Vol 23, No 10, Oct 87 (manuscript received 24 Dec 85) pp 1615-1617

[Article by O. A. Golubeva and G. M. Orlova, Scientific Research Chemistry Institute, Leningrad State University imeni A. A. Zhdanov]

[Abstract] An experimental study of glass formation in the ternary system P-Se-Sb was made, no interaction of components in the binary system P-Sb and no vitrification in the binary systems P-Se, Se-Sb known to occur but the compounds P_4Se_{10}, P_4Se_6, PSe, P_4Se_3, and Sb_2Se_3 known to exist. Specimens of Pse_xSb_y alloys weighing up to 5 g were produced by vacuum smelting in quartz flasks at temperatures up to 780°C and subsequent quenching in water with ice. Specimens having composition along lines PSe_{20}-Sb, PSe_9-Sb, PSe_4-Sb, P_2Se_5-Sb and P_2Se_3-Sb on the constitution diagram were thus produced for microstructural

examination under an MIM-7 metallographic microscope, differential thermal analysis in a Paulik-Paulik-Erdei derivatograph, and x-ray phase analysis in a URS-50 IM diffractometer with filtered Cu-line radiation as well as for measurements of density, hardness, electrical conductivity, and conductivity activation energy. The results have yielded the concentration ranges of both glassy and glassy-crystalline states, also sufficient data for constructing the P_2Se_3-Sb_2Se_3 section of the P-Se-Sb phase diagram. References 4: 3 Russian, 1 Western.

2415/5915

Improving the Supervision of Independent Gold Miners

18420061 Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 11 Oct 87, p 1

[Article: "In the CPSU Central Committee: Comments on the Article 'You Have Not Even Dreamt About It' published in the 13 May 1987 edition of SOTSIALISTICHESKAYA INDUSTRIYA"]

[Text] It has been noted in a resolution adopted by the CPSU Central Committee that the article "You Have Not Even Dreamt About It" published in the 13 May 1987 edition of SOTSIALISTICHESKAYA INDUSTRIYA correctly raised questions concerning serious shortcomings in the organization of the work of independent gold-mining cooperatives. The critical comments of the paper were intended not to discredit the independent mining cooperatives but to eliminate distortions in the practical functioning of this cooperative form of labor organization.

Limiting themselves to frequent assurances regarding the elimination of shortcomings in the organization of the production of gold and other metals by bringing the independent cooperatives into compliance with the requirements of the decrees of the CPSU Central Committee and the USSR Council of Ministers regarding these questions, and being satisfied with the generally positive economic results of independent mining, the managers of the USSR Ministry of Nonferrous Metallurgy fail to draw appropriate conclusions and do not take the measures necessary to establish proper order in the activities of independent mining cooperatives.

The USSR Ministry of Nonferrous Metallurgy and the management of gold-mining associations and enterprises are resigned to the fact that existing regulations regarding independent mining of minerals are being violated. Not infrequently, the cooperatives are assigned deposits that are easier to mine than state deposits. At many assigned mining areas, mining is conducted without regard to nature-protection laws and with gross violations of established practice, as a result of which above-normal losses of metals occur. In a number of cooperatives, fiscal and economic discipline and democratic self-management principles are grossly violated, and citizens' rights are violated. Necessary conditions for the prevention of gold theft, waste, and abuses have not been created at the facilities of the gold-mining industry, particularly in the independent mining cooperatives.

At some locations, party committees and Soviet organs have kept themselves aloof from monitoring of the operations of the independent mining cooperatives. And at many of them, the primary party organizations are inactive. As a result, the independent mining cooperatives are organized without control, frequently according to the principle of nepotism and cronyism. In a number of cases, dishonest, outsiders, whose professional quality and education are below those required for their job, find their way into the management of the cooperatives.

The USSR Procuracy and the USSR Ministry of Internal Affairs are not sufficiently vigorous in directing the activity of the law enforcement agencies in the detection and suppression of crime in the gold-mining industry; they frequently limit their activity to information about accomplished facts.

The CPSU Central Committee has alerted the Collegium of the USSR Ministry of Nonferrous Metallurgy to the lack of discipline shown in the execution of the decrees of the CPSU Central Committee and of the USSR Council of Ministers regarding efficient organization of independent mining of gold and other precious metals and has directed that exhaustive measures aimed at a fundamental correction of shortcomings in this area be taken. It was proposed to put an end to the superficial direction of the independent cooperatives, to thoroughly examine the operation of each of them, and to take steps to ensure that independent mining becomes a truly cooperative form of organization of production based on democratic principles and on principles of fairness in the evaluation of the labor expended by the members of the cooperatives. It is necessary to examine in detail the selection of key personnel and above all the selection of management capable of organizing the cooperatives for achievement of their assigned targets, taking present-day requirements into account.

The USSR Procuracy (Comrade Rekunov) and the USSR Ministry of Internal Affairs (Comrade Vlasov) have been directed to decisively improve the performance of their law-enforcement organs in the area of prevention of crime and of other violations of the law in the gold-mining industry. It is necessary to put an end to delays, to ensure timely detection and investigation of violations of the law, and to take effective measures aimed at suppression of theft and abuses in this industry.

The Kazakhstan Communist Party Central Committee, the Krasnoyarsk and Khabarovsk kray committees, and the Amur, Irkutsk, Magadan, Sverdlovsk, Chita, Komi, and Yakutsk oblast committees of the CPSU have been directed to strengthen the party's control over the formation and organization of the work of independent mining cooperatives, the activity of key personnel, the creation for them of the necessary production and living conditions and the decisive suppression of theft, waste, and abuses at the gold-mining facilities, and to increase the role of the primary party organizations in this area.

The USSR Gosplan, the USSR Ministry of Nonferrous Metallurgy, the USSR Finance Ministry, the USSR Ministry of Justice, the USSR Procuracy, and the USSR Ministry of Internal Affairs, together with local party and soviet organizations and other pertinent departments, have been directed to develop and present for the consideration of the USSR Council of Ministers proposals regarding improvement of the organization of the cooperative mining of minerals.

Crystals: New Scientific Discovery

18420062 Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 30 Oct 87 p 2

[Article by TASS correspondent R. Akhmetov: "Crystals: New Scientific Discovery"]

[Text] Moscow scientists have made a scientific discovery in a very important area of scientific and technical progress--the physics and chemistry of semiconductors. On 29 October it was entered in the USSR registry of discoveries.

All substances are commonly divided into three classes with regard to their ability to conduct electric current: metals, semiconductors, and dielectric materials (insulators). Although semiconductors as a special class of materials have been known for a long time, it had been thought that they showed no promise for serious use in technology. Thus an entry in one of the volumes of the Small Soviet Encyclopedia read as follows: "Semiconductors -- substances having a poor electrical conductivity. Wood and paper are examples of semiconductors."

In the USSR, academician A. F. Ioffe was the first to point out the need to study semiconductors as promising materials for electronics, and he organized their comprehensive study.

A new branch of science and technology -- the physics of semiconductors -- emerged in our country and abroad during the recent decades. The appearance of transistors -- semiconductor amplifiers and generators of electromagnetic oscillations -- provided a powerful stimulus for its development. One of their most important merits is their strikingly small size. The first digital computer, made in the 1940s and operating with radio tubes, occupied an entire room. Today, such a machine operating with transistor devices is placed on a table. The old-fashioned radio receivers, almost as large as a chest of drawers, turned into a small box that is carried in a breast pocket.

In their studies of semiconductor materials, the physicists discovered in them electrical, optical, and other valuable properties that immediately found practical uses. Today semiconductor instruments have found widespread use in cybernetics, solar-power engineering, fiber-optic telecommunication lines, and medical equipment.

Silicon and gallium arsenide remain the basic semiconductor materials. For this purpose they must be extremely pure and must have extremely perfect structure. Only a single impurity atom is permitted for millions or even billions of atoms of the basis material. A miniscule quantity of impurities or defects in a crystal can result in a sharp change in some parameters of a device. This is utilized by technologists to control crystal properties.

Lately compounds of various natural elements, chiefly elements from the third and fifth groups of the periodic table, are increasingly used as semiconductor materials.

It had been thought that an excess of one component is such a compound results in the appearance of micro-voids (vacancies) in a crystal. However, the Moscow scientists have shown that the atoms of the component present in excess can form, in addition to vacancies, areas of increased concentration of such atoms. This results in unusual changes in the crystal properties. The specific resistance changes suddenly, and optical, electrical, and mechanical properties either improve or deteriorate.

This scientific discovery made by Doctors of Technical Sciences M. G. Milvidskiy and V. B. Osvenskiy, Candidate of Technical Sciences, V. V Karatayev from GIREDMET [State Rare-Metal Industry Scientific-Technical and Design Institute of the Order of the October Revolution], and Professor V. T. Bublik and Candidate of Technical Sciences A. P. Veviorskiy from the capital's Steel and Alloys Institute, makes it possible to reliably obtain semiconductor materials with desired properties. For this purpose, it is necessary to accurately maintain the ratio between the components of the compound. On the basis of the results of this discovery, its authors made six inventions pertaining to efficient methods of producing single crystals with desired properties.

12973

UDC 666.1.031:666.24

Effect of Additives to Glass for Acceleration of Founding Process on Spectral Properties of Colored Light Filters

18420055 Moscow STEKLO I KERAMIKA in Russian No 10, Oct 87 pp 14-15

[Article by S. L. Antonova, engineer, State Scientific Research Institute for Glass]

[Abstract] A line of filters for attenuation of laser radiation intensity to levels safe for the human eye has been developed on the basis of Na-Ca silicate glass, with CeO_2 added for filtering out the 0.20-0.40 μm wave band, Nd_2O_3 added for filtering out 0.53 μm radiation, and CuO + Nd_2O_3 added for filtering out 0.63-0.70 μm and 0.84-1.06 μm radiation. An additive which accelerates the glass founding process in a pot furnace at the Gusev Crystal Plant without degrading the filter performance characteristics was sought and Na_2SiF_6 was found to be preferable to NaCl and Sb_2O_3. It intervenes most strongly in the $2CeO_2 + Cu_2O \rightleftarrows 2CuO + C_2O_3$ oxidation-reduction reactions by shifting the equilibrium toward Ce^{IV}, unlike the other two additives. Addition of 2 wt.% Na_2SiF_6 is adequate, ensuring excellent quality of the filter glass without reducing its optical density and increasing its transmission coefficient for radiation at 0.610 μm and 1.06 μm wavelengths beyond allowable limits. References: 4 Russian.

UDC 666.3

Nature of Semiconductor Properties of Ceramic $BaTiO_3$

18420047 Moscow IZVESTIYA AKADEMII NAUK SSSR: NEORGANICHESKIYE MATERIALY in Russian Vol 23, No 10, Oct 87 (manuscript received 13 Dec 85) pp 1722-1725

[Article by M. A. Kvantov, Yu. P. Kostikov and B. B. Leykina]

[Abstract] Semiconductor properties of ceramic $BaTiO_3$ are explained on the basis of available theoretical and experimental data, such properties being acquired by the otherwise dielectric material after it has been doped with a donor oxide. The dependence of the electrical resistivity on the dopant concentration is known to follow a trend characterized by dipping to a minimum, which indicates an interplay of competing mechanisms. As the dopant concentration in the solid solution is increased, the concentration of stabilized Ti^{III} also increases and the electrical resistivity correspondingly decreases. With

a higher dopant concentration in the solid solution, meanwhile, the ceramic begins to oxidize earlier and thus at a higher temperature while cooling down after synthesis so that a thicker dielectric layer will cover the surface of conducting grains. Interaction of components in the $BaTiO_3$-$Ba_6Ti_{17}O_{40}$-donor system alters the composition of the impurity coexisting with perovskitic $BaTiO_3$ so that the eutectic melting point becomes higher and formation of a conducting solid solution is inhibited. Presence of an acceptor oxide compensates some donors such as Ta_2O_5 and not others such as Y_2O_3, in the latter case producing a liquid phase so that oxidation-reduction reactions are stimulated and donor properties of the donor oxide become effective. References 23: 15 Russian, 8 Western.

UDC 546.28

Effect of Electron Bombardment on Etchability of Si Single Crystals

18420048 Moscow IZVESTIYA AKADEMII NAUK SSSR: NEORGANICHESKIYE MATERIALY in Russian Vol 23, No 9, Sep 87 (manuscript received 26 Nov 85) pp 1413-1417

[Article by V. S. Garnyk, S. N. Gorin, A. M. Eydenzon and V. A. Stryukov, Institute of Metallurgy imeni A. A. Baykov, USSR Academy of Sciences]

[Abstract] An experimental study was made concerning electron bombardment of Si single crystals and its effect on defects detectable by selective etching. From dislocation-free n-Si and p-Si single crystals grown by the Czochralski method and doped with boron or phosphorus to concentrations of 10^{14}-10^{17} cm^{-3}, also from n-Si single crystals grown by the floating-zone method and doped with phosphorus to concentrations of $2\cdot10^{13}$-10^{15} cm^{-3} and from one Czochralski n-Si single crystal doped with germanium to 10^{19} cm^{-3} as well as with phosphorus to 10^{15} cm^{-3}, there were cut 1-4 mm thick plates with both 20-30 cm^2 large faces parallel to the $(11\bar{2})$ plane and the ingot axis. Oxygen and carbon concentrations, measured by the infrared absorption method, were $4\cdot10^{17}$-$1.3\cdot10^{18}$ cm^{-3} and $(2\text{-}3)\cdot10^{16}$ cm^{-3} respectively in the Czochralski crystals and each not higher than 10^{16} cm^{-3} in the floating-zone crystals. All specimens were polished with M-28 powder for selective etching with Sirtl reagent (chromate + HF) bebore and after electron bombardment, the 8 MeV electron beam of $6.4\cdot10^{12}$ $cm^{-2}s^{-1}$ intensity impinging normally in pulses of 3.5 μs duration at a repetition rate of 500 Hz to a total dose of $1.3\cdot10^{16}$ electrons/cm^{-2}. The face around the target area was protected by a 5 mm thick tungsten shield, compressed air blowing on both plate and shield inside a water-cooled holder so that their temperature did not exceed 300 K during bombardment. Etching after bombardment revealed a surface microrelief indicating the shape of the crystallization front and not detectable without prior bombardment. Etching after bombardment also produced pits of a different shape than that of pits produced by etching before bombardment and thus revealed swirl defects, their concentration being characteristically very low: $2\cdot10^2$-$8\cdot10^3$ cm^{-2} on a $(11\bar{2})$

plane in slowly grown Czochralski crystals and of the order of 10^2 cm^{-2} in flotating-zone crystals. References 13: 10 Russian, 3 Western (1 in Russian translation).

UDC 666.233

New Superhard Materials and Their Industrial Applications

18420051a Kiev SVERKHTVERDYYE MATERIALY in Russian No 5, Sep-Oct 87 (manuscript received 2 Jul 87) pp 8-14

[Article by N. V. Novikov and A. A. Shulzhenko, Superhard Materials Institute, UkSSR Academy of Sciences, Kiev]

[Abstract] New polycrystalline superhard materials for industrial applications, mainly tool bits, have been developed, tested, and evaluated at the Superhard Materials Institute. They include several grades of synthetic diamonds and several grades of boron nitride as well as various BN-diamond and other composites, their mesh size ranging from 500/400 to 100/80. The diamonds are synthesized at temperatures within the 1370-1670 K range, by a new process which involves regulating the carbon concentration in the melt so that crystals with not more than 0.5 wt.% inclusions are obtained. Two such diamonds, AS 105T and AS 132T, are used for drilling rocks, a third one AS 15 is used for machining tool steels. The other materials are cubic BN "kubonit" KT, "teplonit", "kiborit" for machining special alloys steels with high Ni-Cr content, sphaleritic BN with ceramic binder on hard-alloy substrate for cutter blades, and sphaleritic BN with diamond binder on hard-alloy substrate for machining parts made of AL25 aluminum alloys or silumin cylinders of internal-combustion engines. Disks 8 mm and 13.5 mm in diameter with a 0.7-0.8 mm thick diamond layers on a 2.2-2.8 mm thick hard-alloy substrate have been produced for drilling and boring applications. Progress is being made in producing single diamond crystals with semiconductor properties, 4.5 mm long crystals having already been obtained. References: 7 Russian.

UDC 669.046.558.28

Effect of High Pressure on Sintering of TiC-Base Alloys

18420051b Kiev SVERKHTVERDYYE MATERIALY in Russian No 5, Sep-Oct 87 (manuscript received 17 Nov 85) pp 27-29

[Article by K. Müller and B. Rebsch, Central Metal Physics Institute, GDR Academy of Sciences, Dresden, I. P. Kushtalova and L. F. Stasyuk, Superhard Materials Institute, UkSSR Academy of Sciences, Kiev]

[Abstract] An experimental study of tungstenless hard powder alloys TiC-Mo_2C-Ni was made at the Central Metal Physics Institute in Dresden (GDR) for the purpose of determining the effect of high sintering pressure on their hardness. Powders of TiC with 20.2 wt.% total C content (0.48 wt.% free C), 10.8 wt.% Mo_2C and 10 wt.% Ni were simultaneously mixed and comminuted in a vibratory grinder, then compacted into cylinders 9 mm in diameter and 5 mm high. Paraffin was

used as plasticizer and later removed by annealing at a temperature of 1000°C in a hydrogen atmosphere. These specimens were sintered in a toroidal high-pressure apparatus for 5 min, with the temperature varied over the 1350-1600°C range and the pressure varied over the 10-70 kbar range. For comparison, some specimens were sintered by the conventional method at 1450°C under a vacuum pf 0.1 Pa for 30 min. Specimens sintered at temperatures above 1400°C were found to be almost nonporous. When sintering was done at a constant temperature, the Vickers hardness of specimens first increased up to 21 GPa as the sintering pressure was raised to 43 kbar and then remained at that level as the sintering pressure was raised further. When sintering was done at a constant pressure, the Vickers hardness of specimens first increased to a maximum (21 GPa, when sintering was done under 70 kbar pressure) as the sintering temperature was raised to 1450°C and then decreased as the sintering temperature was raised further. Annealing at 1000°C did not lower the hardness. The results of microstructural examination and x-ray phase analysis indicate that sintering under high pressure inhibits formation of the complex $(TiMo)C_{1-x}$ carbide and regards dissolution of carbide-forming metals in the binder metal. This is why a very hard alloy, as hard as a plain TiC-Ni alloy, with a fine-grain structure is produced. References 8: 3 Russian, 2 East German, 3 Western.

UDC 546.281.261

Mechanical Properties of SiC-AlN Ceramics

18420051c Kiev SVERKHTVERDYYE MATERIALY in Russian No 5, Sep-Oct 87 (manuscript received 12 Mar 86) pp 29-32

[Article by V. K. Kazakov, V. A. Melnikova, S. N. Dub and V. I. Malnev, Superhard Materials Institute, UkSSR Academy of Sciences, Kiev]

[Abstract] An experimental study of SiC-AlN ceramics has demonstrated the feasibility of producing a high-strength material with maximum 3% porosity by hot-pressing a mixture of SiC and AlN powders at a temperature not higher than 1800°C. Mixtures of commercial SiC powder with 3 μm average grain size and 30-90 wt.% ultrafine-disperse AlN powder with 0.1 μm average grain size were compacted under a pressure of 30-35 MPa at a temperature below 1800°C. Square bars 35 mm long and 5x5 mm^2 in cross-section were cut from cylindrical ingots 80 mm in diameter and 8 mm high, to be mechanically tested for flexural strength by the standard method and for hardness with a TP-2 instrument using a 200 N Vickers indenter. Cracking resistance was determined on the basis of measurements with a PMT-3 microhardness tester under a load of 1 N on one of the (0001) surfaces and calculations according to the formula $K_{1c} = 0.0742P/L^{3/2}$ (P - indenter load, L - crack length). The results of these tests and fractography under a "Hitachi-200" electron microscope indicate a gradual breakup of α-SiC single crystals and growth of AlN grains as the AlN content is increased, with attendant interdiffusion and recrystallization of the two compounds. The SiC + 40% AlN material was found to have maximum strength and cracking resistance, the hardness remaining high with up to 60% AlN and all decreasing fast with further increasing AlN content. References: 4 Western.

UDC 621.922.34

Strength of Binding Between Compound Glass and Embedded Diamond Grains

18420051d Kiev SVERKHTVERDYYE MATERIALY in Russian No 5, Sep-Oct 87 (manuscript received 12 Jan 87) pp 42-45

[Article by V. L. Ovchinninkov, Ye. K. Bondarev and V. A. Konovalov, Superhard Materials Institute, UkSSR Academy of Sciences, Kiev]

[Abstract] Retention of diamond grains in a compound glass is evaluated on the basis of experimental data pertaining to AS32 500/400 diamond grains embedded in a compound consisting of STs glass ($PbO-ZnO-B_2O$) and F1 glass ($Na_2O-B_2O_3-SiO_2$). In order to determine the dependence of the binding strength on the founding temperature, the latter was varied over the 450-600°C range with grains embedded in the surface layer. The grain knockout pressure was measured at room temperature to determine its dependence on the grain embedment depth. The binding strength was then calculated in accordance with a formula (V. A. Konovalev) describing its proportionality to the knockout pressure with correction factors accounting for the average weighted grain diameter and the ratio of embedment depth to that diameter. The binding strength evidently decreases from 335±28 MPa in glass founded at 450°C to 270±32 MPa in glass founded at 600°C. Accordingly, this compound glass retains diamond grains better than do metallic binders such as M1, M3, MZh, MO3. References: 4 Russian.

UDC 621.9.045-669.018

Structure and Properties of Defective Layer of Ceramic After Cutting With Periodically Pulsed Laser Beam

18420051e Kiev SVERKHTVERDYYE MATERIALY in Russian No 5, Sep-Oct 87 (manuscript received 6 Nov 86) pp 50-53

[Article by P. S. Kislyy, V. S. Kovalenko, A. V. Lavrionovich, and I. V. Manzheleyev, Superhard Materials Institute, UkSSR Academy of Sciences; Kiev Polytechnical Institute]

[Abstract] High-strength ceramic consisting of hot-pressed Si_3N_4 with Ti_3N_4 inclusions was cut experimentally with a high-intensity pulsed laser beam for an examination of the defective layer. Cutting was done with pulses of 60 W average power and 0.3 μs duration from a twin LTI-502 laser, their repetition rate being varied over the 10-30 kHz range. A study of the defective layer by x-ray structural analysis and x-ray spectral microanalysis as well as measurement of hardness as an indicator of mechanical properties have revealed erosion and sublimation of the material with subsequent formation of liquid SiO_2 drops and amorphous SiO_2 fibers upon oxidation, then of an SiO_2 film curing the microcracks after thermal fracture and brittle fracture. The microhardness was found to be higher after curing than initially after hot-pressing, the dispersion of particles having decreased and the diffusion zone having widened along the interphase boundaries. The defective layer thus evidently recovers as a result of annealing. References 2: 1 Russian, 1 Western.

UDC 621.791:658.5.011.46

Improving Metal Economy in Machine Building and Construction by Strengthwise Differentiation of Rolled Stock

18420052a Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 10, Oct 87 pp 1-4

[Article by Academician B. Ye. Paton, A. A. Kazimirov, candidate of technical sciences, and L. M. Lobanov, doctor of technical sciences, Electric Welding Institute imeni Ye. O. Paton]

[Abstract] A procedure for determining the economic effectiveness of reducing the metal content of designs in machine building and construction is outlined which, if adopted as a single standard for all industry, will improve metal economy nationwide. It involves strengthwise differentiation of rolled stock into two groups and use of quality control statistics based on inspection for a critical property with an appropriately widened acceptance or rejection band. It is demonstrated on the basis of tests using 10 mm thick strip of ВСт3сп (?) steel and 20 mm in diameter reinforcement rods of 35MnSi steel. The procedure ought to be incorporated in applicable State All-Union Standards and technical specifications.

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Cost Effectiveness of Using Differentiated Rolled Stock for Tank Cars of Welded Construction

18420052b Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 10, Oct 87 pp 4-6

[Article by N. I. Panashchenko, candidate of technical sciences, and L. V. Katyukha, engineers, Electric Welding Institute imeni Ye. O. Paton]

[Abstract] A comparative analysis of producing railroad tank cars of welded construction with rolled 09Mn2Si or 09Mn2Si-2 steel, the basic grade having been differentiated into a lower-strength group 09Mn2Si-1 and a higher-strength group 09Mn2Si-2, reveals that using steel of the 09Mn2Si-2 group will lower not only the cost of tank car construction but also the cost of tank car operation. This is indicated by a lower metal content, on account of a thinner boiler plate, and a more reliable operation in service. The economic impact of differentiating rolled stock for welded structures, generally, will extend to savings of fuel and energy, auxiliary materials, in labor and capital. References: 6 Russian.

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UDC 621.791.72:621.791.052:539.4.014

Residual Stresses in Welded Joints Produced by Electron-Beam Welding of Steel, Titanium Alloy, and Aluminum Alloy

18420053 Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 10, Oct 87 pp 24-25

[Article by A. A. Antonov, doctor of technical sciences, V. N. Kazarov, engineer, N. N. Yevgrafov, candidate of technical sciences, A. I. Makarov, engineer, and Yu. T. Lysenkov, candidate of technical sciences]

[Abstract] An experimental study of electron-beam welding was made for the purpose of determining the residual stresses in welded joints as an indicator of performance capability under alternating tension-compression load. Flat plates 20 mm thick and 200 mm wide were welded together edgewise, plates of 12Cr18Ni10Ti steel with a beam current of 190 mA or 90 mA, plates of 1201 aluminum alloy with a beam current of 130 mA or 90 mA, and plates of WT16-ch titanium alloy with a beam current of 115 mA or 100 mA. The accelerating voltage was 60 kV and the welding rate was 20 m/h in all cases. Residual stresses were measured by the laser-interference method. The longitudinal ones were found to be tensile and the transverse ones were found to be compressive on both face and root side of the seam in all cases, those in steel near the yield strength, those in the titanium alloy somewhat lower than the yield strength, and those in the aluminum alloy much lower than the yield strength. References: 3 Russian.

2415/5915

Call for Comprehensive Use of Mineral Resources

18420059b Moscow EKONOMICHESKAYA GAZETA in Russian No 42 Oct 87 p 11

[Article by A. Kunarev, senior scientific associate, VIEMS [USSR Ministry of Geology and USSR Academy of Science All-Union Scientific Research Institute for Raw Material and Geological Exploration Economics] under the rubric "The Reader Continues the Discussion": "Discard Stereotypes"]

[Text] There is no arguing with the conclusions of the article "So That Minerals Are Developed Comprehensively" (EG No. 11). Today the need has actually arisen to take the entire raw mineral complex into one hand, to do away with the uncoordinated branch principle by which minerals are predicted and used.

Today time itself requires that we rethink our entire strategy of "geo-use". We must discard our former unfounded stereotypes, which were constructed on the principle of "surplus appropriation" and are in some measure even parasitic in terms of raw mineral resources.

Under the conditions in which they occur "customarily" for modern technology, "traditional" minerals will be exhausted in the foreseeable future. Consequently, we must also revise our attitude to "geo-use" on the basis of actual mineral capacities, taking into account not only the situation today, but also tomorrow.

It seems that the new approach to the relationships among resource, processing, and producing branches should consist in applying the principle by which geo-resource branches would carry out a systematic, accelerated, and continuous study of all mineral substances, constantly informing processing and producing branches via the State Cadaster regarding the actual existence of various types of natural mineral matter and its properties and distribution in the Earth at that time and in the future. With these data, processing and producing branches should construct their own plans and production policy, and formulate their orders to mining branches with regard for these realities.

Comprehensive development of mineral resources requires that they be completely inventoried and that they be thoroughly studied from the very initial stages of geological exploration. That is, study not only to find natural mineral substances which are minerals today, but those which may become such tomorrow during the development of the NTR [scientific-technical revolution].

It seems that the need has also arisen to prepare and develop operating instructions which define general principles for the use of nature in the USSR, including geo-use, on the basis of the USSR Law on the State Enterprise (Association).

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Eliminating Mineral Waste in the Metals Industry

18420059a Moscow EKONOMICHESKAYA GAZETA in Russian No 42 Oct 87 p 11

[Article by S. Fatyanov, senior scientific associate of the USSR Council of Ministers ANKh [Academy of National Economy] under the rubric "Toward Resources--Thriftily": "Double Loss: How To Eliminate Inefficient Use of Mineral Wealth"]

[Text] As a result of legal, administrative, and economic measures adopted in recent years, the planning of the use of the country's raw mineral potential has somewhat improved. However, there has not yet been a radical change in the efficiency with which it is used. Raw material losses during mining, processing, transportation, and use are still high. EKONOMICHESKAYA GAZETA has written about this more than once.

Of course, certain losses are inevitable. At least half of them are no longer justified economically, but are a unique sort of toll paid on the road to economic development. If the country's national economy were to continue to develop along this road, there would have to be a 10-15 percent increase in fuel and raw material recovery and 30-40 percent in capital investment, and an additional 8-10 million people would have to be employed in each five-year plan. But we don't have these capabilities, nor, by the way, is there a need for them. Any scarcity is a result of extensive management, not the lack of production resources. As noted at the June (1987) Plenum of the CPSU Central Committee, the attempt to check the decline in growth rates by extensive methods has led to exorbitant expenditures to expand the fuel and energy branches, the accelerated involvement of new natural resources in production, and their inefficient use.

Today a radical increase in the efficiency with which raw mineral resources are used is a key factor in intensifying the country's economy and accelerating its socioeconomic development. However, as experience shows, no wishes, appeals, or the strict injunctions of current nature preservation laws can solve the problem of the integrated and effective use of natural resources.

Under the new management conditions, the economic methods of control formulated in the USSR Law on the State Enterprise (Association) "Basis Statutes for Fundamental Restructuring of the Control of the Economy," must be the primary levers for thrifty use of mineral resources.

In principle, management conditions in the mining and processing branches of the national economy cannot be identical. Natural factors have a tremendous effect on the final results of production in mining branches. By the way, the results of the testing of the new management methods in 1984-1986 at mining industry enterprises eloquently attest to this. They did not take into account the specifics of this branch and copied--with slight changes--the conditions of the economic experiments being conducted at that time in the processing industries. As a result, a real threat arose that the efficiency with which raw mineral resources are used would drop. Meanwhile, any economically unjustified loss or shortage of mineral stock is converted into a double loss for the national economy: first, in the form of capital unjustifiably spent for exploration for, and commercial development of, irretrievably lost raw mineral resources. Second, because of additional and ever-increasing expenditures to make up for the lost resources by exploring for and developing new deposits.

As practice has shown, this double loss may not even affect the enterprises' profits. Moreover, there are almost always ways they can improve their financial position even if mineral/raw material resource output declines. This is no surprise. Even today the effect the economic mechanism has on the efficiency with which minerals are used has been limited only to certain fines and economic incentives which are mostly preventive. They have not had, nor can they have any noticeable effect on increasing mineral output. The fact is that only by thorough re-equipment of mining and processing enterprises can the efficiency with which natural resources are used be increased and the resources replaced by secondary raw materials. And this requires that economic conditions which would incite everyone involved in mining to action -- to continuously search for and make practical use of the most effective scientific-technical and organizational-economic innovations to increase the efficiency with which mineral and raw material resources are used -- be created for all participants in the "mineral exploration-finished product output" cycle.

The USSR Law on State Enterprise affords tremendous opportunities for establishing a direct relationship between the efficiency with which the mineral and raw material resources of mining and processing enterprises are used and their cost-accounting income (profit). However, to take advantage of these opportunities in raw mineral complex (MSK) branches, the unique features of the mining industry must be fully taken into account when the new law is applied. These include the length of the "mineral exploration-finished product output" cycles, high one-time capital investments into new construction, expansion, reconstruction, and re-equipment of operating mining and processing enterprises, and also high current labor costs. Therefore, the solution to the problem of increasing the efficiency with which mineral resources are used is hindered by substantial impediments such as the significant lag between the time an enterprise undertakes to increase its cost-accounting income by improving the use of mineral-raw material resources and the time it takes to achieve this in practice.

Factors such as depletion, nonrenewability, and the many purposes for which an industrial consumer uses raw mineral resources also have a great influence on mining.

To construct a complete, flexible and, at the same time, efficient system of incentives which take into account these unique features and are aimed at meeting the requirements of article 20 of the Law, which addresses the comprehensive use of minerals, we must first have an objective and economically justified criterion for the level of integration and, therefore, the efficiency with which mineral wealth is used. Its decline at any time must be classified as an inefficient use of raw mineral resources and a violation of the Law on mineral resources. In our opinion, a standard expressing the minimum economically justified level of complete extraction of mineral constituents and their processing into a finished product could be such a criterion.

The proposed standard is essentially economic. It relates state-wide interests in the comprehensive and efficient development of minerals to the cost-accounting interests of the mining enterprise. Of course, it should be stable and set for enterprises along with other long-term norms for the overall five-year plan, or with a breakdown by year on the basis of the plan for the development of mining or a planned change in the quality of the raw material to be processed. It should also reach MSK enterprises in good time. An industry-wide norm for total extraction of mineral constituents should be established for ministries and departments which mine and process raw mineral stock so that the process of integrated mineral use can be controlled at the branch level.

The implementation of the proposed norm in the regulation of MSK enterprises' economic activity fully complies with the USSR Law on State Enterprise. In stipulates that economic norms define the relationship to the budget, the formation of the wage fund, economic incentive funds, and other aspects of an enterprise's economic activity and be set with regard for unique regional features. We might add that these features are inherent to all MSK branches.

As an economic incentive for MSK enterprises to increase the level of complete extraction of mineral constituents and their processing into finished product beyond the established rate, we should introduce into the economic mechanism mineral consumers' priority rates of payment for minerals, as well as transfers to the budget for the ministry. It has been proposed that they be set up for mining and processing enterprises and associations which, on their own initiative, have undertaken a set of high-efficiency scientific-technical and organizational-economic measures in order to bring about a substantial increase in the yield of raw mineral output. This means a double gain for society -- the conservation of mineral wealth and the saving of state capital for exploration and commercial development of new mineral/raw material sources.

However, these priority norms will "begin to work" only if they are set at a level which ensure complete coverage of extra expenditures related to carrying out these measures, stable cost-accounting income (profit) for the innovator enterprise, and a rise in material and social benefits for the labor collective.

Apparently, mining and processing enterprises which have achieved an actual increase in mineral constituent extraction and processing into finished

product as compared to the norm should be permitted to allocate a guaranteed, preset portion of the savings they achieve for enlarging economic incentive funds and for raising the salaries of enterprise managers, specialists, workers, and everyone else involved in the introduction and use of innovations. In calculating these savings, we must taken into account all the state capital saved in the exploration and commercial development of new deposits and in the development of alternative sources of raw material or its import.

Extensive introduction of this incentive system in the management practice of the mining and processing branches fully complies with the new law, which stresses that enterprises, associations, and organizations which have achieved successes as a result of scientific-technical competition and have won the competition have priority for tangible and intangible incentives and increase their profits (income).

To expand and accelerate the replacement of primary mineral-raw material resources with secondary raw material and wastes, we must allow associations, enterprises, and organizations which develop or procures them to sell this secondary raw material and wastes on the basis of direct, long-term management relationships or in wholesale trade through the territorial offices of USSR Gossnab [State Committee for Material and Technical Supply] at contracted prices and according to specifications.

To increase the material incentive for associations, enterprises, and organizations to expand deliveries of secondary raw material and wastes which replace primary mineral-raw material resources to consumers and to create economic conditions for lowering their prices, we must apparently arrange it so that no transfers to the state budget and ministry are deducted from the profit from their sale.

Along with extensive use of incentives, the new legislation offers great opportunities for imposing severe economic sanctions on negligent users of nature. Thus, article 20 states that enterprises compensate for a loss caused by inefficient use of natural resources and be material responsible for failure to comply with nature preservation legislation. To apply this legal statute in MSK branches, it must be stipulated that, for economically unjustified raw material losses which lead to a reduction in the established norm for start-to-finish extraction of mineral constituents into final product, enterprises will transfer the cost (at wholesale prices) of the lost crude mineral and the mineral constituents it contains to the income of the all-union budget to compensate for the expenditure of state capital for commercial development of the lost raw mineral resources. In addition, enterprises which have permitted these losses are obliged to transfer to the state budge additional moneys required to make good the full cost (at wholesale prices) of the lost raw mineral resources. These sums (compensating for the double loss from unjustified waste of raw mineral resources) to the state budget will unquestionably be transferred at the expense of the cost-accounting income available to the appropriate associations and enterprises.

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Foil Line Goes Into Operation

18420060b Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 22 Nov 87 p 1

[Article by staff correspondent V. Lagovskiy, dateline Moscow: "Now--Without Import"]

[Text] The first foil line has begun operating in a new shop of the Moscow Copper Smelting and Electrolyte Plant.

It's a spellbinding picture: a wide, gleaming strip of copper foil creeps out of the electrolysis bath in an endless, unbroken stream. A machine slowly winds it into coil.

"The lead bath is the anode," explains A. Nesvitskiy, head of the plant's design-planning department. "Inside is a titanium drum--the cathode. Between them we pour a solution of copper sulfate and sulfuric acid. A very thin copper film is deposited on the drum during electrolysis. The process is simple and reliable. By the end of the year, the entire shop will begin to run on full cycle--from foil production to processing."

"Difficulties began with foil import," says plant director K. Viksne. "We had to immediately set up our own ou'put."

But, in reality every cloud has a silver lining. Although, to be honest, another saying comes to mind here--the peasant won't cross himself until he hears thunder. But once it has, you ask, how do you quickly place new lines in an existing enterprise?

"We rebuilt like this: we didn't close the old plant right away, but began to wind it down gradually, at the same time setting up the new one," says the director. "As a result, the collective was retained, and things were brought on stream. At first, admittedly, we bought equipment abroad, but with the help of specialists from Gintsvetmet [State Scientific Research Institute for Nonferrous Metals], we quickly created our own. The first domestic units are producing foil as good as any import."

But something else is important to Muscovites: there is no hint of odor from fumes or sulfuric acid, either on the territory of the plant or around it. With the startup of the new assemblies, the old "dirty" plant completely ceased to exist. Before the plant processed copper scrap; in a former time clouds of soot and sulfur gas spewed from its shops. Now they no longer pollute the capital's atmosphere. Even the negligible amount of aerosol which still evaporates from the electrolysis units does not end up outside.

Ion exchange resin filters thoroughly clean the air. There are no complaints from the health services about the quality of the water leaving the plant either. But even this flow is scheduled to stop in time. Fine-cleaning facilities will be set up at the plant, and it will switch to a closed water supply.

Leaving the modernized enterprise, I noticed a stand. On it was a certificate reading "To the plant collective from the All-Union Society For Nature Preservation."

12809/5915

Phase Two of Belorussian Metallurgical Plant Operating

18420060a Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 22 Nov 87 p 1

[TASS article, datelined Gomelskaya oblast under the rubric "Speed. Quality. Economy"; "Turnkey Plant Goes Into Operation: The Second Phase of the Belorussian Metallurgical Plant Has Produced Goods"]

[Text] This plant will produce 25,000 tons of metal cord and 10,000 tons of side wire. These goods are intended for the tire-makers of Bobuysk, Belaya Tserkov, Dnepropetrovsk, and Nizhnekamsk. The enterprise, in whose construction Austrian, Italian, West German, and Yugoslav companies took part, should reach designed capacity by the end of the five-year plan.

In terms of engineering approaches and control devices, the enterprise in Zhlobin is unparalleled. The entire two-week process cycle has been automated: from startup of rod production from ultra-pure steel to the shop for braiding bronze-plated wire into cord. Five of the eight types of cord will be produced for the first time in this country. Materials handling is assigned to robot carts. There is no need for human intervention in finished product stock-taking and warehousing. On the whole, the extremely complex mechanism of the complex, which is assembled under one roof, must operate faultlessly. Only one break per 180,000 meters of finished metal cord is permitted. This matches the world's best products. Labor productivity here will be 3-4 times higher than in related enterprises in the branch.

A meeting was held in Zhlobin to sign the protocol on transfer and acceptance of the complex and to turn over the symbolic key to the plant. This does not mark the completion of the project on the banks of the Dnepr. The third phase of the BMZ [Belorussian Metallurgical Plant] is ahead.

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